SECTION 1

AVIATION WEATHER: TAKING A LEADERSHIP ROLE

THE FEDERAL AVIATION ADMINISTRATION IS RESPONSIBLE FOR PROVIDING NATIONAL AND INTERNATIONAL LEADERSHIP IN THE OPTIMIZATION OF WEATHER SYSTEMS AND SERVICES. THIS LEADERSHIP MANIFESTS ITSELF THROUGH THE MANAGEMENT OF A SAFE AND EFFICIENT NATIONAL AIRSPACE SYSTEM AND THE ENCOURAGEMENT OF CONSENSUS AND COOPERATION BETWEEN GOVERNMENT AGENCIES, PRIVATE WEATHER SERVICES, RESEARCH ORGANIZATIONS, AND AVIATION WEATHER USERS GROUPS.

INTRODUCTION

Weather is a leading cause of many aircraft accidents and a contributing factor in many others. According to a report published by the Aircraft Owners and Pilots Association (AOPA) Air Safety Foundation, 5,894 weather-related General Aviation accidents occurred (roughly 27 percent of all accidents) from 1982 to 1993. These accidents resulted in 1,750 fatalities with an estimated annual cost of $784 million.

Recent accident data from the National Transportation Safety Board (NTSB) corroborate the findings of the Air Safety Foundation and further identify weather as a major contributor to air-carrier accidents. In addition to accidents, weather is the main reason for transportation delays, causing about 65percent of all commercial aircraft delays in the United States. Therefore, weather remains a critical factor affecting the National Airspace System (NAS) and presents many challenges for the Federal Aviation Administration (FAA).

United States public laws and regulations governing aviation require the FAA to ensure the safe and efficient conduct of air commerce within the NAS. Because of weather's importance in the successful execution of that mission, the FAA is taking a leadership role in aviation weather concerns.

This article outlines the FAA's actions and accomplishments for bringing improved aviation weather services to NAS users — from the newest student pilot to the experienced operator of sophisticated, high-performance commercial aircraft.

ACTIONS AND ACHIEVEMENTS

In 1994, the FAA requested a review of aviation weather services from National Research Council (NRC). The Council provided the results of their review in a 1995 report entitled: *"Aviation Weather Services - A Call for Federal Leadership and Action."* Based on this report, the FAA took several actions.

Establishment of Aviation Weather Focal Point and Directorate

The FAA Administrator elevated the importance of weather to the FAA by appointing the Associate Administrator for Air Traffic Services (ATS-1) as the focal point for the agency's aviation weather services. This appointment increases the visibility of weather programs to higher levels of FAA management. In addition, the FAA created the Aviation Weather Directorate within Air Traffic Services to focus on policy making, planning, coordination, standards, evaluation of products and services, requirements, and development of investment strategies for aviation weather services. Previously, several organizations within the FAA carried out these responsibilities.

The New Aviation Weather Directorate's goals (right box) outlines the responsibilities and changes stated above.

In order to fulfill its leadership role in aviation weather, the FAA needed more than organizational changes and a new directorate. Its response was to develop long-term guidance and external relationships to meet its mission.

The new Aviation Weather Directorate will:

- **Serve as the federal government's focal point for determining, developing, and understanding aviation weather needs and requirements of all civil users of the NAS. This is accomplished through a strong program of internal and external liaison and coordination with other government agencies, external stakeholders (such as Congress), industry customers (airlines and aviation organizations), international bodies (such as the International Civil Aviation Organization and World Meteorological Organization), and other FAA offices.**

- **Establish, monitor, and maintain standards of performance and metrics for aviation weather services. This includes training and certification requirements and standards for aviation weather service personnel as well as for information/data sources, e.g., limited aviation weather reports and non-federal automated aviation weather observing systems.**

- **Develop a comprehensive long-range plan and a financial database for the FAA's aviation weather infrastructure. This includes requirements management, acquisition and Integrated Program Team (IPT) support, and life-cycle management of all aviation weather systems in the FAA.**

This article was prepared by the FAA's Aviation Weather Policy Division (ARW-100) Staff.

LEADERSHIP ROLE DEFINED

In September of 1997, the FAA Administrator signed an Aviation Weather Policy Statement that acknowledges the importance of aviation weather to the NAS. In addition, this policy statement established the FAA's leadership in providing the required weather products and services to the civil aviation community. To guide this effort, the FAA led an interagency group, through the Office of Federal Coordinator for Meteorology (OFCM), to develop a 10-year National Aviation Weather Program Strategic Plan centered on the following guidelines that will:

- **PROVIDE IMPROVED AVIATION WEATHER INFORMATION**
- **ENHANCE THE ABILITY OF DECISION MAKERS TO USE THE NEW INFORMATION**
- **FACILITATE IMPROVEMENTS BY FORGING THE REQUIRED INSTITUTIONAL ARRANGEMENTS**
- **DIRECT AND USE RESEARCH RELATED TO AVIATION WEATHER**

The subsequent strategic plan, prepared by the National Aviation Weather Program Council and published in April of 1997, addresses issues related to key priorities of the federal agencies, describes the overall investment strategies for the future mix of aviation weather services and products, and addresses the roles and responsibilities of public and private sectors in aviation weather.

Following the publication of the plan, work began on the National Aviation Weather Initiatives, to be published in 1998. This document focuses on eight service areas and establishes a set of initiatives centered around elements of the strategic plan.

As part of defining the roles and responsibilities of the public and private sectors, the FAA worked with both the National Weather Service (NWS) and private industry. An important aspect of aviation weather service is interagency support, with an emphasis on the relationship between the FAA and NWS. This unique relationship has evolved from earlier congressional legislation. The 1995 NRC report found that: *"Developing a common understanding of aviation weather requirements between the FAA and NOAA (National Oceanic and Atmospheric Administration - parent agency of NWS) is the critical first step in assessing current aviation weather services and planning improvements."* This finding supported the report's recommendation that the FAA take a leadership role in defining its users' requirements for meteorological services and communicating them to the NWS. In response, the FAA completed an initiative to gather its requirements and will document them in an annual requirements letter from the Secretary of Transportation to the Secretary of Commerce.

With regard to the private-sector, the Administrator issued a policy statement defining an overall strategy for the implementation of a Flight Information Service (FIS) data-link capability in the NAS. This strategy represents a unique and collaborative model between the public and private sector — allowing industry to provide the bulk of FIS data-link services while the government supplies in-kind assistance, such as radio frequencies for communications.

SPECIFIC ACCOMPLISHMENTS

The installation and commissioning of Automated Surface Observing Systems (ASOS) is continuing rapidly and is based on guidance developed early in the program. In November of 1994, senior management officials from the FAA and the NWS met with executives from 14 national aviation associations to discuss surface weather observation services. The outcome of this was an agreement for the government to work together with industry to define service standards for surface observations. As a result, a government and industry team assessed the needs for surface observations at the Nation's airports. Their effort resulted in an agreement to implement a four-level service standard for ASOS sites. These service standards were published in the Federal Register and were implemented in July of 1996. To provide the appropriate observational service, the FAA uses automated systems, human observers, or a mix of the two. The box below describes the four levels of service.

LEVEL D SERVICE is provided by a standard, stand-alone Automated Weather Observing System (AWOS) or an Automated Surface Observing System (ASOS). In the future, as many as 600 airports worldwide may have Level D service.

**LEVEL C SERVICE includes the ASOS/AWOS, plus augmentation by control tower personnel. When in operation and observed, tower personnel will add to the report: thunderstorms, tornadoes, hail, tower visibility, volcanic ash, and virga.
Level C service covers about 250 airports.**

**LEVEL B SERVICE includes all of the weather parameters in Level C service plus Runway Visual Range (RVR), and the following, when observed: freezing drizzle versus freezing rain, ice pellets, snow depth and snow increasing rapidly remarks, thunderstorm and lightning location remarks, and remarks for observed significant weather not at the station.
Level B service covers about 57 airports.**

**LEVEL A SERVICE includes all of the weather parameters in Level B service plus 10-minute averaged RVR for long-line transmission or additional visibility increments of 1/8, 1/16, and 0 miles.
Level A service covers about 78 airports.**

The criteria ranking airports into the four levels of service is based on airport operation, weighed by the incidence of bad weather, distance to the nearest suitable alternate airport, and critical airport characteristics. Subsequent reviews of the service standards in 1997 and 1998 reaffirmed the ranking criteria established in 1996. The standards have shown the flexibility to adjust appropriately to changes in airport traffic and other critical characteristics.

In addition to fielding ASOS, several other significant milestones have been accomplished within the FAA and other agencies to improve aviation weather services. These improvements include:

- **The first ever forecast of freezing precipitation aloft at the NWS Aviation Weather Center (AWC) in Kansas City.**

- **Upgrades to WSR-88D algorithms to better identify storm cells and detect hail.**

- **Initiation of the Water Vapor Sensing System program in cooperation with the United Parcel Service (UPS) to install airborne humidity sensors on six UPS aircraft as a precursor to icing detection and weather forecasting.**

- **Operating a Chicago testbed to provide ground deicing decision-making information to United Airlines, American Airlines, and the City of Chicago.**

- **Implementing the Rapid Update Cycle (RUC) II at NWS as the operational model in April of 1998. The RUC-II provides better horizontal and vertical resolution and is able to explicitly forecast parameters that adversely impact aviation.**

- **The AWC in 1997 established initial operating capability with the Aviation Digital Data Service (ADDS) component of the Aviation Gridded Forecast System (AGFS).**

- **Forecasters produced a 1-hour terminal convective product for testing at the Dallas-Fort Worth airport. A national scale convective weather product was available for the airlines use during the summer of 1998.**

- **Automated the integration of radar and snow gauge data to provide guidance products for managing the use of deicing fluid, holdover times, and departures at the Denver International, Chicago O'Hare, and New York LaGuardia airports.**

The FAA also has in place a number of acquisition programs aimed at improving detection and forecasting hazardous weather, including dissemination of weather products to improve safety.

Many of these programs deal with wind shear and microburst detection. The programs resulted from NTSB investigations and recommendations following a series of fatal air carrier accidents from the late 1970's to the mid 1980's. The FAA has made sizable investments in all aspects of wind shear and microburst detection research and development, systems acquisition, training, and education. The cornerstone of the FAA's wind shear detection acquisition programs is the Terminal Doppler Weather Radar (TDWR). The FAA is currently installing 45 TDWRs at the major United States airports with climatological characteristics amenable to the formation of low-level wind shear. An additional 33 airports will be equipped with less expensive wind shear detection devices based on Doppler technology incorporated in Airport Surveillance Radar (ASR). Finally, 110 additional airports in the country will continue to operate the existing Low-Level Wind Shear Alert System (ILWAS). A handful of LLWASs will be enhanced with additional anemometers, central processors, and taller masts.

In addition, the FAA formed partnerships with the NWS and the Department of Defense to implement a network of next-generation weather radar — the Weather Surveillance Radar 1998 Doppler (WSR-88D). These agencies recently completed a nationwide installation of WSR-88Ds, significantly enhancing the capability to detect convective activity, thunderstorms, tornadoes, and other hazardous weather phenomena. Also, the FAA and the NWS have nearly completed the installation of the Automated Weather Observing System (AWOS) and its more sophisticated companion system, the Automated Surface Observing System (ASOS).

The FAA is in the process of implementing two major programs: the Weather and Radar Processor (WARP) and the Integrated Terminal Weather System (ITWS). WARP and ITWS are paired to provide aviation weather processing and product generation and display capability to air traffic controllers throughout the NAS. WARP will be fielded in three stages with Stages 1 and 2 becoming operational in the year 2000.

WARP will provide the Center Weather Service Unit (CWSU) meteorologists with a meteorological workstation and accompanying tool sets. WARP will also provide connectivity to the Display System

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Replacement (DSR) (controllers' common console) and furnish it with WSR-88D data. WARP Stage 3, which incorporates future advances, will be operational after the year 2000. ITWS will integrate weather data from automated surface observing systems, Doppler weather radar, and low-level wind shear alert systems, together with NWS data and products, to forecast aviation impact variables, such as convection, visibility, icing, and wind shear, including downbursts. ITWS is expected to be operational by the year 2003 at the 45 airports currently slated to receive TDWRs.

Finally, the FAA also intends to fully replace the aging Flight Service Station Automation System with a state-of-the-art system — the Operational and Supportability Implementation System (OASIS). OASIS will integrate graphics weather display functions and perform flight service data handling tasks. It is scheduled to be fully operational by the year 2002 at current automated Flight Service Stations and 14 remote Alaskan sites.

Despite the recent improvements and innovations, opportunities to create better aviation weather products and services still exist. Aviation weather research and development (R&D), in coordination with NASA and other agencies, is a key element of the FAA's ability to satisfy users' present and future requirements.

RESEARCH & DEVELOPMENT

Many of the recommendations made by external users during the National Aviation Weather Users Forum in 1993 dealt with improving the quality and content of the weather products and services. The FAA acknowledged the need for improvement in these areas and the FAA Administrator's Aviation Weather Policy defines the agency's commitment *"...research, development, and acquisition are focused on products that will improve the safety and efficiency of the air traffic system."*

In quantitative terms, the safety goal of the FAA Associate Administrator for Research and Acquisition is *"...through research, identify methods that, when implemented, would reduce the fatal aviation accident rate by 80 percent by 2007 as compared to 1990-1996 baseline data."* Additionally, to address system efficiency, the goal is to *"develop and demonstrate the capability of new systems to decrease the rate of delays due to weather by 10 percent by 2002."* If the FAA invests wisely in today's research to understand present day challenges, a stronger system can be built which will improve the overall quality of the NAS.

In the past decade, the FAA initiated several major R&D programs to study, develop, and implement better weather detection and prediction capability. These programs address a wide range of safety related atmospheric phenomena, such as thunderstorms, turbulence, icing, visibility, and wind shear, that have safety implications. These programs also complement NASA's research in aircraft systems and design.

A major area of concern in recent years has been the downward pressure on the FAA's aviation weather R&D budget, which has led to wide fluctuations in funding levels from one year to the next. Another problem pointed out in the NRC report has been the inadequate focus on R&D planning which has led to a fragmented approach that does not prioritize activities based on users needs. In response, the FAA formed an integrated team with representatives from the FAA, NWS, and the research laboratories to streamline and prioritize R&D activities.

The direction of the current Aviation Weather Research (AWR) program is to expand applied research. One objective is to solve operational problems in concert with users and to lead the development of new and improved algorithms to predict meteorological events that impact aviation. Another objective is to seek alternatives for the implementation of research results either through existing FAA and NWS platforms or through technology transfers to private weather service providers supporting aviation. In addition, a limited amount of basic meteorological research is intended to advance the basic understanding of the atmospheric processes that lead to development of hazardous weather.

The strategy being used in the AWR program is to work in concert with the operational elements of the FAA as well as other R&D activities such as NASA's Aviation Safety Program to better match research efforts with requirements. In order to foster collaboration between the laboratories and ensure that duplicative efforts are identified and eliminated, the agency formed several meteorological product development teams. Finally, to demonstrate early success and to build support for the program, the focus has been shifted to near-term projects.

CONCLUSION

The FAA has accepted the leadership role in aviation weather. Internal organizational changes have placed more emphasis on weather as a key component of the FAA mission. Aviation weather is also a component of the FAA Administrator's "Safer Skies Agenda." The FAA has chaired interagency groups, established a strategic vision, and developed supporting initiatives for a safer and more efficient NAS.

System acquisition programs to enhance the detection, display, and dissemination of hazardous weather information are in place, and R&D in areas critical to aviation safety, such as in-flight icing and turbulence, are producing new products for operational use. The NWS Aviation Weather Center, the central forecast center for civil aviation users, has already initiated new products for forecasting hazardous conditions.

Providing aviation weather services is a team effort. The FAA has increased coordination with the NWS and NASA and has reached out to the private sector to build a strong team. It is imperative that the FAA maintain its leadership role and continue to build on the successes already achieved.